

Neotropical Monogenoidea. 30. Ancyrocephalinae (Dactylogyridae) of Piranha and Their Relatives (Teleostei, Serrasalminae) from Brazil: Species of *Calpidothecium* gen. n., *Calpidothecioides* gen. n., *Odothecium* gen. n., and *Notothecioides* gen. n.

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ABSTRACT: Two species of *Calpidothecium*, 2 species (1 new) of *Calpidothecioides*, 1 new species of *Odothecium*, and 1 new species of *Notothecioides* (Dactylogyridae, Ancyrocephalinae) are described and/or reported from the gills of 4 species of Serrasalminae from the Brazilian Amazon: *Calpidothecium crescentis* (Mizelle and Price, 1965) comb. n. (syn. *Urocleidus crescentis* Mizelle and Price, 1965), *C. serrasalmus* (Mizelle and Price, 1965) comb. n. (syn. *Cleidodiscus serrasalmus* Mizelle and Price, 1965), and *Calpidothecioides pygopristi* sp. n. from *Pygopristis denticulata*; *Odothecium raphidiophallum* sp. n. from *Catoprion mento*; and *Notothecioides llewellyni* sp. n. from *Myelus torquatus* and *M. rubripinnis*. Four new genera are proposed: *Calpidothecium* is characterized by dactylogyrids with a single vagina opening sinistrolaterally, 1 pair of eyes, overlapping gonads, a seminal vesicle representing a dextral loop of the vas deferens, and a distal rod of the accessory piece with terminal branches; *Calpidothecioides* is characterized by species with a double vagina (left branch opening sinistrolaterally, right branch looping right cecum and opening on the dorsomedial body surface), 1 pair of eyes, overlapping gonads, a seminal vesicle comprising a dextral loop of the vas deferens, and a simple termination of the distal rod of the accessory piece; *Odothecium* is characterized by helminths with a single vagina looping the left cecum and opening on the middorsal body surface, 2 pairs of eyes, overlapping gonads, a seminal vesicle representing a dextral loop of the vas deferens, and a hook-shaped termination of the distal rod of the accessory piece; *Notothecioides* is characterized by species with the vagina looping the left cecum and opening on the middorsal body surface, 2 pairs of eyes, overlapping gonads, a sigmoid seminal vesicle, and a simple or hook-shaped termination of the distal rod of the accessory piece. *Urocleidus orthus* Mizelle and Price, 1965, is transferred to *Calpidothecioides*.

KEY WORDS: Monogenoidea, Dactylogyridae, Ancyrocephalinae, *Calpidothecioides* gen. n., *Calpidothecium* gen. n., *Notothecioides* gen. n., *Odothecium* gen. n., *Calpidothecioides orthus* comb. n., *Calpidothecioides pygopristi* sp. n., *Calpidothecium serrasalmus* comb. n., *Calpidothecium crescentis* comb. n., *Notothecioides llewellyni* sp. n., *Odothecium raphidiophallum* sp. n., Serrasalminae, *Catoprion mento*, *Pygopristis denticulata*, *Myelus rubripinnis*, *Myelus torquatus*, Amazon Basin, Brazil.

The present paper is the third of 4 contributions dealing with the Ancyrocephalinae from the gills of Serrasalminae from the Brazilian Amazon (see Kritsky et al. [1996, 1997, 199X]) and includes the proposal of 4 new genera. Three new species are described; and *Urocleidus crescentis* Mizelle and Price, 1965, *U. orthus* Mizelle and Price, 1965, and *Cleidodiscus serrasalmus* Mizelle and Price, 1965, are reassigned to neotropical genera.

Methods of host [*Catoprion mento* (Cuvier), *Myelus torquatus* (Kner), *M. rubripinnis* (Müller

and Troschel), and *Pygopristis denticulata* (Cuvier)] and parasite collection, preparation of helminths for study, measurement, and illustration are those of Kritsky et al. (1986, 1996). Measurements, all in μm , represent straight-line distances between extreme points and are expressed as a mean followed by the range and number of specimens measured in parentheses; body length includes that of the haptor; length of the accessory piece is that of the distal rod. Measurements of internal organs (gonads and pharynx), the body, and haptor bars were obtained from stained unflattened specimens; those of the anchors, hooks, and copulatory complex were from unstained specimens mounted in Gray and

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Wess' medium. Numbering (distribution) of hook pairs follows that recommended by Mizelle (1936; see Mizelle and Price [1963]). Type and voucher specimens are deposited in the helminth collections of Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil (INPA); the United States National Parasite Collection, Beltsville, Maryland (USNPC); and the University of Nebraska State Museum (HWM), as indicated in the respective descriptions or accounts. For comparative purposes, the following specimens also were examined: holotype (USNPC 60465), *Urocleidus crescentis* Mizelle and Price, 1965; holotype (USNPC 60466), *U. orthus* Mizelle and Price, 1965; and holotype (USNPC 60464), *Cleidodiscus serratalmus* Mizelle and Price, 1965.

Taxonomic Account

Class Monogenoidea Bychowsky, 1937
Order Dactylogyridea Bychowsky, 1937
Dactylogyridae Bychowsky, 1933
Ancyrocephalinae Bychowsky, 1937
Calpidothecium gen. n.

DIAGNOSIS: Body fusiform, comprising cephalic region, trunk, peduncle, haptor. Tegument thin, smooth, or with scaled annulations. Two terminal, 2 bilateral cephalic lobes; head organs, unicellular cephalic glands present. Anterior eyes absent, infrequently represented by single cluster of granules; granules elongate ovate. Mouth subterminal, midventral; pharynx muscular, glandular; esophagus short; intestinal ceca 2, confluent posterior to testis, lacking diverticula. Gonads intercecal, overlapping; testis dorsal to germarium. Vas deferens looping left intestinal cecum; seminal vesicle comprising a dextral loop of vas deferens, with circular muscles in wall. Two saccate prostatic reservoirs; prostates comprising rosette of glandular areas lying in dorsal field of anterior trunk. Genital pore midventral near level of cecal bifurcation. Copulatory complex comprising articulated copulatory organ, accessory piece; copulatory organ tubular, single ramus opening terminally or subterminally; distal rod of accessory piece with terminal digitations, proximal articulation process present. Vagina nonsclerotized; vaginal aperture sinistrolateral; vaginal duct opening proximally to anterior wall of seminal receptacle; seminal receptacle lying on midline anterior to germarium. Haptor subhexagonal; with pairs of dorsal

and ventral anchor/bar complexes, 7 pairs of similar hooks with ancyrocephaline distribution. Hooks similar; each with delicate point, truncate protruding thumb, expanded shank comprising 2 subunits; proximal subunit variable in length between hook pairs. FH loop extending to union of shank subunits. Ventral bar lacking antero-medial projection. Parasites of gills of serrasal-mid fishes.

TYPE SPECIES: *Calpidothecium crescentis* (Mizelle and Price, 1965) comb. n. from *Pygocentrus nattereri* (type host) and *Pygopristis denticulata*.

OTHER SPECIES: *Calpidothecium serratalmus* (Mizelle and Price, 1965) comb. n. from *Pygocentrus nattereri* (type host) and *Pygopristis denticulata*.

REMARKS: *Calpidothecium* is characterized by dactylogyrids, with a single vagina opening sinistrolaterally, 1 pair of eyes, overlapping gonads, a seminal vesicle representing a dextral loop of vas deferens, and a distal rod of the accessory piece with terminal branches. It is apparently sister group of *Calpidothecioides* gen. n. based on 2 synapomorphies: lost or tendency to lose the anterior pair of eyes, and presence of a seminal vesicle with circular muscles in its wall. It differs from *Calpidothecioides* by lacking a dextral branch of the vagina. The generic name is from Greek (*kalpidos* = an urn + *theke* = a small case).

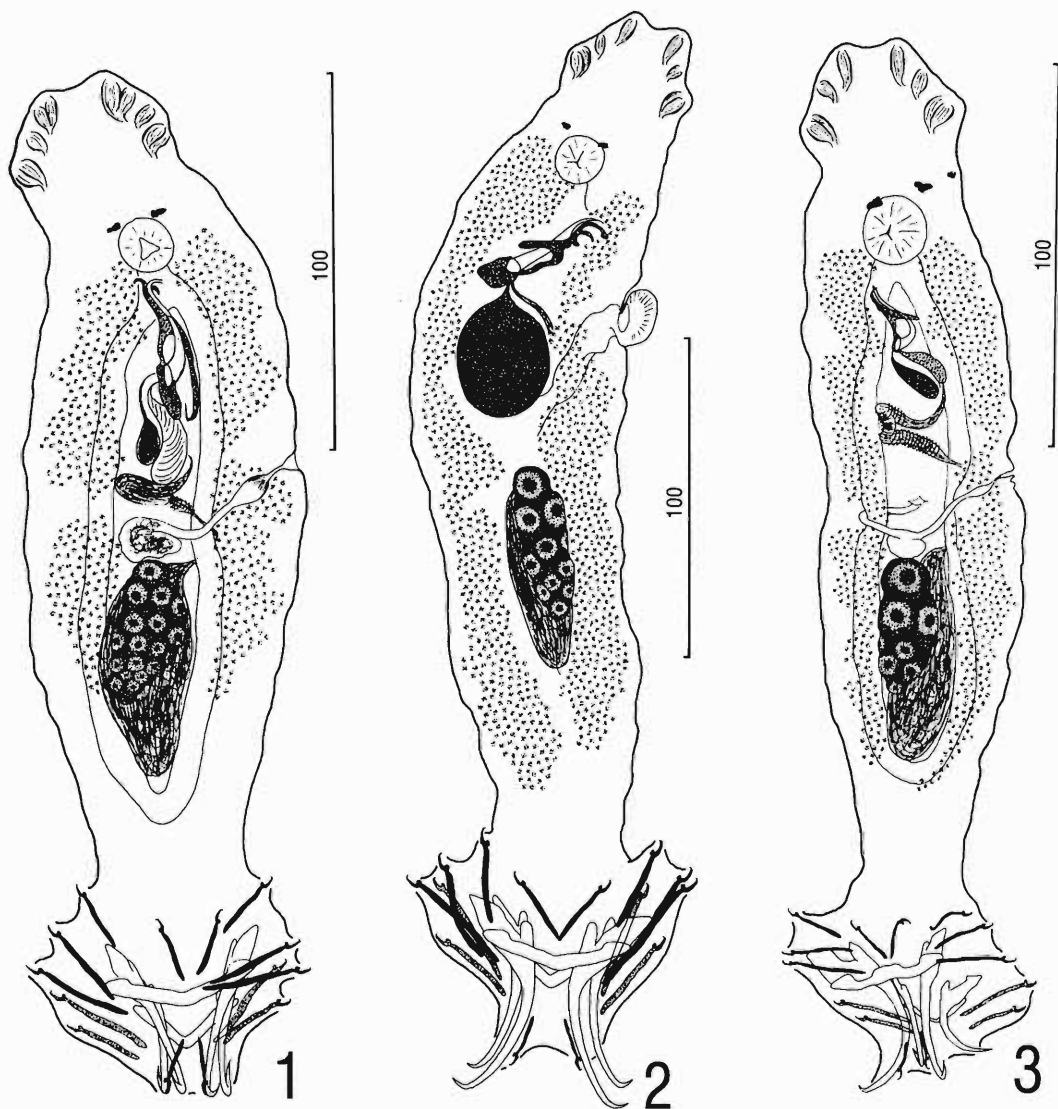
Calpidothecium crescentis
(Mizelle and Price, 1965) comb. n.
(Figs. 1, 4–11)

SYNONYM: *Urocleidus crescentis* Mizelle and Price, 1965.

RECORDS: *Pygopristis denticulata*: Rio Uatuma, Lago Tapaná, near Santana, Amazonas (58°00'W 02°38'S) (3 November 1989); Rio Xingu, Parana Maxipana, Pará (52°02' 12"W 02°17' 41"S) (17, 18 October 1992); Rio Araguari, Lago Comprido, Amapá (50°08' 12"W 01°22'21"N) (15 August 1992).

PREVIOUS RECORD: *Pygocentrus nattereri* (type host). Amazon River (type locality). The original host was obtained from Steinhart Aquarium, San Francisco, California (Mizelle and Price, 1965).

SPECIMENS STUDIED: Holotype from *Pygocentrus nattereri*, USNPC 60465; 47 vouchers from *Pygopristis denticulata*, USNPC 85891, 85892, 85893.



Figs. 1–3. Whole mount illustrations of *Calpidothecium* spp. and *Calpidothecioides pygopristi* sp. n. (composite, ventral views). Fig. 1. *Calpidothecium crescentis* (Mizelle and Price, 1965) comb. n. (from *Pygopristis denticulata*). Fig. 2. *Calpidothecium serrasalmus* (Mizelle and Price, 1965) comb. n. (from *Pygopristis denticulata*). Fig. 3. *Calpidothecioides pygopristi* sp. n. All drawings are to respective 100- μ m scales.

REDESCRIPTION: Body 275 (206–341; $n = 13$) long; greatest width 75 (56–94; $n = 13$) near midlength or in anterior trunk. Tegument infrequently with scaled annulations in posterior trunk, peduncle. Cephalic lobes moderately developed. Accessory eye granules usually present in cephalic, anterior trunk regions. Pharynx spherical, 15 (12–18; $n = 13$) in diameter. Peduncle broad; haptor 74 (64–89; $n = 13$) long, 83 (62–98; $n = 13$) wide. Anchors similar; each

with depressed superficial root, prominent deep root, moderate to long shaft, short point; ventral anchor 46 (41–50; $n = 23$) long, base 17 (14–18; $n = 19$) wide; dorsal anchor 38 (35–40; $n = 23$) long, base 12 (11–14; $n = 18$) wide. Ventral bar 38 (36–40; $n = 12$) long, bent at midlength, with subterminal, terminal enlargements; dorsal bar 32 (30–33; $n = 11$) long, broadly U- or V-shaped, with slightly enlarged ends directed laterally. Hook pair 1–20 (18–22; $n = 12$),

pair 2—22 (21–25; $n = 15$), pair 3—27 (25–29; $n = 18$), pair 4—29 (27–31; $n = 12$), pair 5—14–15 ($n = 15$), pair 6—21 (19–23; $n = 14$), pair 7—28 (26–30; $n = 16$) long. Copulatory organ 28 (25–32; $n = 23$) long, tapered, usually recurved distally; base with sclerotized margin, prominent proximal flap. Accessory piece 33 (29–36; $n = 25$) long; proximal articulation process elongate, flattened; distal rod with free proximal end, bifurcate distally. Testis pyriform, 54 (42–64; $n = 6$) long, 27 (19–31; $n = 6$) wide; germarium subovate, 53 (38–67; $n = 6$) long, 18 (16–19; $n = 6$) wide. Dextral loop of vas deferens (seminal vesicle) conspicuous; sinistral prostatic reservoir with spiralling muscular wall. Oviduct, ootype, uterus not observed; vaginal pore a simple indentation of tegument, vagina having subterminal dilation with inverted funnel-shaped series of sclerotized ridges; vitellaria limited in trunk, absent in regions of reproductive organs.

REMARKS: This species, originally placed in *Urocleidus* by Mizelle and Price (1965), is the type species of *Calpidothecium* gen. n. It differs from *C. serrasalmus* by possessing a bifurcate end of the distal rod of the accessory piece and by lacking a fleshy pad immediately posterior to the vaginal pore.

Calpidothecium serrasalmus
(Mizelle and Price, 1965) comb. n.
(Figs. 2, 12–20)

SYNONYM: *Cleidodiscus serrasalmus* Mizelle and Price, 1965.

RECORD: *Pygopristis denticulata*: Rio Uatuma, Lago Tapaná, near Santana, Amazonas (58°00'W 02°38'S) (3 November 1989).

PREVIOUS RECORD: *Pygocentrus nattereri* (type host). Amazon River (type locality). The original host was obtained from Steinhart Aquarium, San Francisco, California (Mizelle and Price, 1965).

SPECIMENS STUDIED: Holotype from *Pygocentrus nattereri*, USNPC 60464; 2 vouchers from *Pygopristis denticulata*, USNPC 85894.

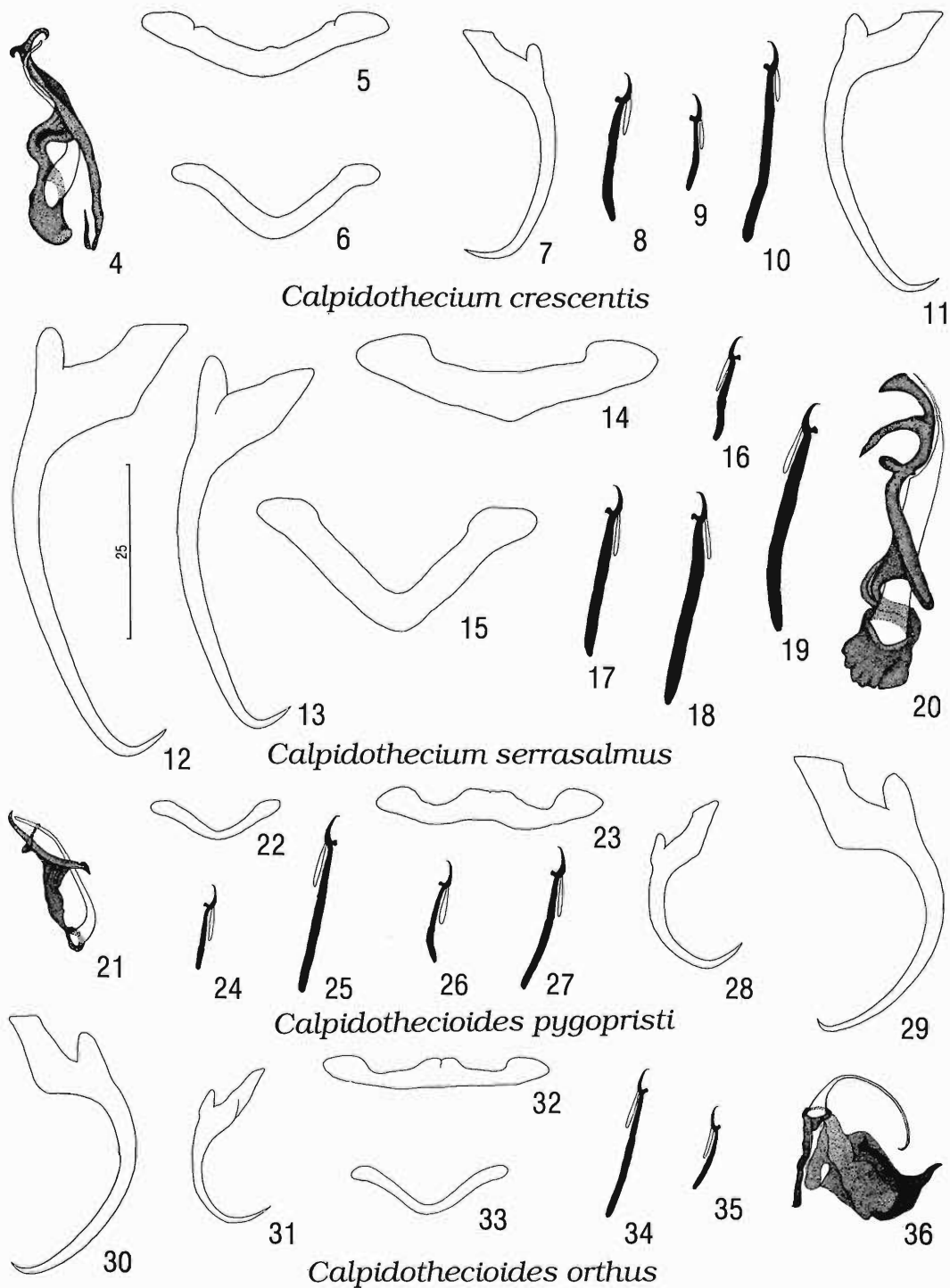
REDESCRIPTION: Body 340 (334–345; $n = 2$) long; greatest width 87 (75–99; $n = 2$) in anterior trunk. Tegument smooth. Cephalic lobes moderately developed. Eyes 2, anterior cluster of eye granules infrequent; granules small; accessory granules absent (1 granule found in position of missing anterior eye in 1 specimen).

Pharynx spherical, 15 ($n = 1$) in diameter. Peduncle broad; haptor 88 (87–90; $n = 2$) long, 103 (85–121; $n = 2$) wide. Anchors similar; each with depressed superficial root, prominent deep root, elongate shaft, short point; ventral anchor 62 (61–64; $n = 2$) long, base 21–22 ($n = 2$) wide; dorsal anchor 55 ($n = 2$) long, base 16 (14–17; $n = 2$) wide. Ventral bar 45 ($n = 1$) long, slightly bent near midlength, with enlarged terminations; dorsal bar 41 ($n = 1$) long, V-shaped, with enlarged ends. Hook pairs 1, 6—25–26 ($n = 4$), pair 2—27–28 ($n = 2$), pair 3—31 (29–32; $n = 2$), pairs 4, 7—34 (32–35; $n = 4$), pair 5—17 ($n = 2$) long. Copulatory organ 40 (32–48; $n = 2$) long, a broad straight tube with arcuate diagonal aperture; base with sclerotized margin, short proximal flap. Accessory piece 32 (28–35; $n = 2$) long; distal rod with 3 distal branches. Gonads subovate; testis 46 ($n = 1$) long, 21 ($n = 1$) wide; germarium 47 ($n = 1$) long, 18 ($n = 1$) wide. Seminal vesicle not observed; 1 prostatic reservoir observed, large, saccate. Oviduct, ootype, uterus, seminal receptacle not observed; vagina with light to minimal sclerotization at aperture, opening in anterior trunk, dilated, protruding pad posterior to aperture; vitellaria limited in trunk, absent in regions of reproductive organs.

REMARKS: Although some features of the internal anatomy could not be determined from the holotype and 2 voucher specimens, this species is assigned to *Calpidothecium* based on presence of terminal branches of the distal rod of the accessory piece, comparative morphology of the anchors and bars, and the position of the vaginal aperture. *Calpidothecium serrasalmus* differs from *C. crescentis* by possessing larger haptoral sclerites and in the comparative morphology of the copulatory organs.

***Calpidothecioides* gen. n.**

DIAGNOSIS: Body fusiform, comprising cephalic region, trunk, peduncle, haptor, Tegument thin, smooth, or with scaled annulations. Two terminal, 2 bilateral cephalic lobes; head organs, unicellular cephalic glands present. Eyes 2; granules elongate ovate. Mouth subterminal, midventral; pharynx muscular, glandular; esophagus short; intestinal ceca 2, confluent posterior to testis, lacking diverticula. Gonads intercecal, overlapping; testis dorsal to germarium. Vas deferens looping left intestinal cecum; seminal vesicle comprising a dextral loop of vas defer-



Figs. 4-36. Sclerotized structures of *Calpidothecium* spp. and *Calpidothecioides* spp. Figs. 4-11. *Calpidothecium crescentis* (Mizelle and Price, 1965) comb. n. (from *Pygopristis denticulata*). Fig. 4. Copulatory complex (ventral view). Fig. 5. Ventral bar. Fig. 6. Dorsal bar. Fig. 7. Dorsal anchor. Fig. 8. Hook pair 1. Fig. 9. Hook pair 5. Fig. 10. Hook pair 7. Fig. 11. Ventral anchor. Figs. 12-20. *Calpidothecium serrasalmus*

ens, with circular muscles in wall. Two saccate prostatic reservoirs; prostates comprising glandular areas in dorsal field of anterior trunk. Genital pore midventral near level of cecal bifurcation. Copulatory complex comprising articulated copulatory organ, accessory piece; copulatory organ tubular, single ramus opening terminally; distal rod of accessory piece sigmoid, proximal articulation process present. Vagina double, non-sclerotized; sinistral branch opening sinistrolaterally; dextral branch looping right cecum, opening on middorsal surface of trunk; vaginal ducts leading to anterior wall of seminal receptacle; seminal receptacle lying on midline anterior to germarium. Haptor subhexagonal; with pairs of dorsal and ventral anchor/bar complexes, 7 pairs of hooks with ancyrocephaline distribution. Hooks similar; each with delicate point, truncate protruding thumb, expanded shank comprising 2 subunits; proximal subunit variable in length between hook pairs. FH loop extending to union of shank subunits. Ventral bar lacking anteromedial projection. Parasites of gills of serrasalmid fishes.

TYPE SPECIES: *Calpidothecioides pygopristi* sp. n. from *Pygopristis denticulata*.

OTHER SPECIES: *Calpidothecioides orthus* (Mizelle and Price, 1965) comb. n. from *Pygo-centrus nattereri*.

REMARKS: *Calpidothecioides* is characterized by species with a double vagina (left branch opening sinistrolaterally, right branch looping the right cecum and opening on the dorsomedial body surface), 1 pair of eyes, overlapping gonads, a seminal vesicle comprising a dextral loop of the vas deferens, and a simple termination of the distal rod of the accessory piece. The feature differentiating this genus from its apparent sister taxon, *Calpidothecium*, is presence of a double vagina (single sinistral branch in *Calpidothecium*). The generic name indicates similarity of this genus to *Calpidothecium*.

***Calpidothecioides pygopristi* sp. n.**
(Figs. 3, 21–29)

TYPE HOST AND LOCALITY: *Pygopristis denticulata*: Rio Uatumã, Lago Tapaná, near Santana, Amazonas (58°00'W 02°38'S) (3 November 1989).

OTHER RECORDS: *Pygopristis denticulata*: Rio Xingu, Parana Maxipana, Pará (52°02' 12"W 02°17' 41"S) (17, 18 October 1992); Rio Araguari, Lago Comprido, Amapá (50°08' 12"W 01°22' 21"N) (15 August 1992).

SPECIMENS STUDIED: Holotype, INPA PLH 332; 17 paratypes, INPA PLH 333, PLH 334, PLH 335, USNPC 85895, 85896, 85897, HWML 38618.

DESCRIPTION: Body 275 (273–277; $n = 2$) long; greatest width 60 (56–64; $n = 2$) at various levels in trunk. Tegument infrequently with scaled annulations on posterior trunk, peduncle. Cephalic lobes moderately developed. Accessory eye granules usually absent, occasionally in cephalic, anterior trunk regions. Pharynx spherical, 18 ($n = 2$) in diameter. Peduncle broad; haptor 58 (57–59; $n = 2$) long, 69 (66–71; $n = 2$) wide. Ventral anchor 40 (38–42; $n = 15$) long, with large depressed superficial root, prominent deep root, evenly curved shaft and point, tip of point recurved; base 15 (13–17; $n = 12$) wide. Dorsal anchor 25 (23–27; $n = 10$) long, with elongate depressed superficial root, short deep root, curved shaft, elongate point; base 11 (10–12; $n = 9$) wide. Ventral bar 32 (31–33; $n = 2$) long, thickened medially, with enlarged terminations; dorsal bar 21 ($n = 2$) long, delicate, broadly V-shaped, with slightly enlarged ends. Hook pairs 1, 5–15 (14–16; $n = 13$), pairs 2, 6–17 (16–19; $n = 12$), pair 3–21 (19–23; $n = 5$), pair 4–23 (22–24; $n = 5$), pair 7–27 (25–28; $n = 6$) long. Copulatory organ 21 (18–23; $n = 13$) long, delicate, tapered; base with sclerotized margin, lacking proximal

(Mizelle and Price, 1965) comb. n. (from *Pygopristis denticulata*). Fig. 12. Ventral anchor. Fig. 13. Dorsal anchor. Fig. 14. Ventral bar. Fig. 15. Dorsal bar. Fig. 16. Hook pair 5. Fig. 17. Hook pair 1. Fig. 18. Hook pair 3. Fig. 19. Hook pair 7. Fig. 20. Copulatory complex (ventral view). Figs. 21–29. *Calpidothecioides pygopristi* sp. n. Fig. 21. Copulatory complex (ventral view). Fig. 22. Dorsal bar. Fig. 23. Ventral bar. Fig. 24. Hook pair 5. Fig. 25. Hook pair 7. Fig. 26. Hook pair 1. Fig. 27. Hook pair 3. Fig. 28. Dorsal anchor. Fig. 29. Ventral anchor. Figs. 30–36. *Calpidothecioides orthus* (Mizelle and Price, 1965) comb. n. Fig. 30. Ventral anchor. Fig. 31. Dorsal anchor. Fig. 32. Ventral bar. Fig. 33. Dorsal bar. Fig. 34. Hook pair 7. Fig. 35. Hook pair 1. Fig. 36. Copulatory complex. All drawings are to the 25- μ m scale.

flap. Distal rod of accessory piece 15 (14–17; $n = 15$) long, terminally acute; articulation process with free terminal projection. Gonads subovate; testis 49 ($n = 1$) long, 24 ($n = 1$) wide; germarium 37 ($n = 1$) long, 20 ($n = 1$) wide. Seminal vesicle comprising a slight dilation of dextral loop of vas deferens, encircled by muscular fibers. Oviduct, ootype, uterus not observed; vaginal pores lightly sclerotized; seminal receptacle small; vitellaria limited in trunk, absent in regions of reproductive organs.

REMARKS: *Calpidothecioides pygopristi* resembles *C. orthus* in morphology of the haptor armament. It differs from this species by lacking an elongate proximal flap on the base of the copulatory organ and by possessing a free termination of the articulation process of the accessory piece. The specific name is derived from the generic epithet of its host.

Calpidothecioides orthus
(Mizelle and Price, 1965) comb. n.
(Figs. 30–36)

SYNONYM: *Urocleidus orthus* Mizelle and Price, 1965.

PREVIOUS RECORD: *Pygocentrus nattereri*: Amazon River (type locality). The original host was obtained from Steinhart Aquarium, San Francisco, California (Mizelle and Price, 1965).

SPECIMEN STUDIED: Holotype, USNPC 60466.

REMARKS: The holotype (the only known specimen of this species) is mounted unstained in glycerine jelly and is twisted, with the anterior end in lateral view and the posterior end in a dorsoventral orientation. Haptor structures closely resemble those of *Calpidothecioides pygopristi*. Details of the copulatory complex are problematical in the holotype in that the complex apparently was damaged during slide preparation (Fig. 36). The elongate proximal flap of the base of the copulatory organ appears to be composed of a different substance from that of the remaining portion of the base, and it may be an artifact. The distal rod of the accessory piece is apparently displaced, and the articulation process may have been broken away from the base of the copulatory organ; the lightly stippled portion of Figure 36 may be an artifact resulting from this damage.

The assignment of this specimen to *Calpidothecioides* is based on the comparative mor-

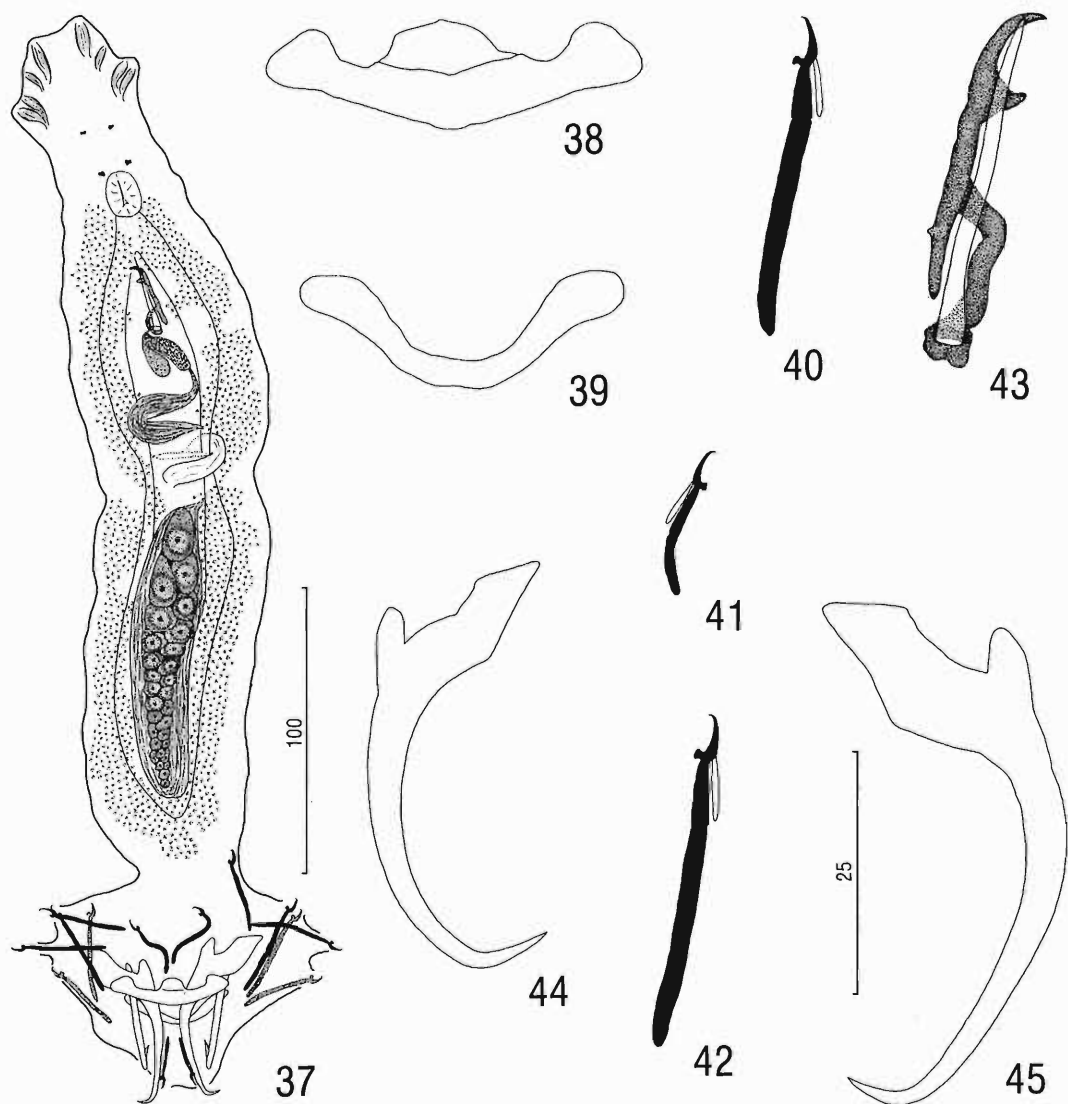
phology of the haptor armament and copulatory complex and presence of a single pair of eyes. Details of the internal anatomy could not be determined from the unstained holotype.

***Odothecium* gen. n.**

DIAGNOSIS: Body fusiform, comprising cephalic region, trunk, peduncle, haptor. Tegument thin, smooth. Two terminal, 2 bilateral cephalic lobes; head organs present; cephalic glands unicellular, lateral or posterolateral to pharynx. Eyes 4; granules elongate ovate. Mouth subterminal, midventral; pharynx muscular, glandular; esophagus short; intestinal ceca 2, confluent posterior to gonads, lacking diverticula. Gonads intercecal, overlapping; testis dorsal to germarium. Vas deferens apparently looping left intestinal cecum; seminal vesicle a C-shaped dilated loop of vas deferens extending into right half of trunk; 2 saccate prostatic reservoirs. Copulatory complex comprising articulated copulatory organ, accessory piece; copulatory organ with single ramus; accessory piece comprising distal rod, proximal articulation process. Seminal receptacle absent; vagina looping left intestinal cecum, dilated, nonsclerotized, opening on mid-dorsal surface near body midlength. Genital pore midventral near level of intestinal bifurcation. Vitellaria coextensive with intestine. Haptor subhexagonal, with dorsal and ventral anchor/bar complexes, 7 pairs of hooks with ancyrocephaline distribution. Hooks similar; each with delicate point, truncate protruding thumb, expanded shank comprising 2 subunits; proximal subunit variable in length between hook pairs. FH loop extending to union of shank subunits. Ventral bar with shield-like anteromedial process. Parasites of gills of serrasalmid fishes.

TYPE SPECIES: *Odothecium raphidiophallum* sp. n. from *Catoprion mento*.

REMARKS: *Odothecium* is monotypic and is characterized by helminths with a single vagina looping the left cecum and opening on the mid-dorsal body surface, 2 pairs of eyes, overlapping gonads, a seminal vesicle representing a dextral loop of the vas deferens, and a hook-shaped termination of the distal rod of the accessory piece. It is apparently related to *Notothecioides*, from which it differs by including species with a dextral loop of the vas deferens, a shield-like anteromedial process on the ventral bar, a dilated vagina, and a fusiform body. The generic name



Figs. 37–45. *Odothecium raphidiophallum* sp. n. Fig. 37. Whole mount (composite, ventral view). Fig. 38. Ventral bar. Fig. 39. Dorsal bar. Fig. 40. Hook pair 1. Fig. 41. Hook pair 5. Fig. 42. Hook pair 7. Fig. 43. Copulatory complex (dorsal view). Fig. 44. Dorsal anchor. Fig. 45. Ventral anchor. All figures are drawn to the 25- μ m scale, except Fig. 37. (100- μ m scale).

is from Greek (*hodos* = a way + *theke* = a small case).

***Odothecium raphidiophallum* sp. n.**
(Figs. 37–45)

TYPE HOST AND LOCALITY: *Catoprion mento*: Balbina, Rio Uatumã, Amazonas (59°28'22"W 01°53'15"S) (20 September 1985).

OTHER RECORDS: *Catoprion mento*: Rio

Uatumã, Lago Tapaná, near Santana, Amazonas (58°00'W 02°38'S) (3 November 1989); Furo do Catalão, Manaus, Amazonas (59°55'W 03°09'S) (5 January 1989).

SPECIMENS STUDIED: Holotype, INPA PLH 336; 17 paratypes, INPA PLH 337, PLH 338, USNPC 85898, 85899, 85900, HWML 38619.

DESCRIPTION: Body with constriction near midlength, 387 (324–442; $n = 7$) long; greatest

width 87 (72–107; $n = 10$) in anterior trunk. Cephalic lobes moderately developed. Eyes equidistant; posterior eyes larger than anterior eyes; accessory granules absent. Pharynx ovate, 17 (15–19; $n = 11$) wide. Peduncle broad; haptor 83 (78–89; $n = 11$) long, 104 (87–116; $n = 11$) wide. Anchors similar; each with elongate depressed superficial root, prominent deep root, elongate shaft, short to moderately long point. Ventral anchor 57 (54–59; $n = 6$) long, base 23 (22–24; $n = 6$) wide; dorsal anchor 45–46 ($n = 4$) long, base 17 (14–18; $n = 4$) wide. Ventral bar 40 (38–41; $n = 9$) long, bent at midlength, with enlarged ends, anteromedial shield-like process short; dorsal bar 32 (30–34; $n = 8$) long, broadly U-shaped, with slightly enlarged ends directed laterally. Hook pairs 1, 3–38 (37–39; $n = 5$), pair 2–33 (32–34; $n = 3$), pair 4–42 (41–43; $n = 3$), pair 5–18–19 ($n = 4$), pair 6–28 (25–30; $n = 5$), pair 7–40 (38–42; $n = 3$) long. Copulatory organ 38 (34–42; $n = 6$) long, a straight slightly tapered tube; base with sclerotized margin, lacking flap. Distal rod of accessory piece 31 (27–33; $n = 6$) long, with large terminal hook, subterminal triangular thumb. Testis bacilliform, 97 (77–108; $n = 8$) long, 25 (22–28; $n = 8$) wide; germarium elongate pyriform, 97 (72–112; $n = 9$) long, 22 (18–30; $n = 9$) wide. Seminal vesicle delicate. Oviduct, oo-type, uterus not observed.

REMARKS: By monotypy, *Odothecium raphid-iophallum* is the type for the genus. Its name is derived from Greek (*raphidos* = a needle + *phallos* = penis) and refers to the shape of the copulatory organ.

Notothecioides gen. n.

DIAGNOSIS: Body fusiform, comprising cephalic region, trunk, peduncle, haptor. Tegument thin, smooth. Two terminal, 2 bilateral cephalic lobes; head organs, unicellular cephalic glands present. Eyes 4; granules elongate ovate. Mouth subterminal, midventral; pharynx muscular, glandular; esophagus short; intestinal ceca 2, confluent posterior to testis, lacking diverticula. Gonads intercecal, overlapping; testis dorsal to germarium. Vas deferens apparently looping left intestinal cecum; seminal vesicle comprising a sigmoid dilation of vas deferens. Two saccate prostatic reservoirs; prostates comprising bilateral glandular areas lying dorsal to anterior portions of ceca. Genital pore midventral near level of cecal bifurcation. Copulatory complex com-

prising articulated copulatory organ, accessory piece; accessory piece with distal rod, proximal articulation process. Vagina looping left intestinal cecum, opening on middorsal surface of trunk, with sclerotized plate at aperture; seminal receptacle present, a proximal dilation of vaginal duct. Haptor subhexagonal, with dorsal and ventral anchor/bar complexes, 7 pairs of similar hooks with ancyrocephaline distribution. Hooks similar; each with delicate point, truncate protruding thumb, expanded shank comprising 2 subunits; proximal subunit variable in length between hook pairs; FH loop extending to union of shank subunits. Ventral bar lacking anteromedial process. Parasites of gills of serrasalmid fishes.

TYPE SPECIES: *Notothecioides llewellyni* sp. n. from *Myleus torquatus* (type host) and *M. rubripinnis*.

REMARKS: *Notothecioides* is monotypic and is characterized by species with the vagina looping the left cecum and opening on the middorsal body surface, 2 pairs of eyes, overlapping gonads, a sigmoid seminal vesicle, and a simple or hook-shaped termination of the distal rod of the accessory piece. It differs from related genera, *Odothecium*, *Notothecium*, and *Enallothecium*, by lacking a dextral C-shaped loop of the vas deferens forming the seminal vesicle. In *Notothecioides* species, the seminal vesicle is a sigmoid dilation of the vas deferens lying in the left side of the trunk. The generic name indicates similarity of this genus to *Notothecium*.

Notothecioides llewellyni sp. n. (Figs. 46–55)

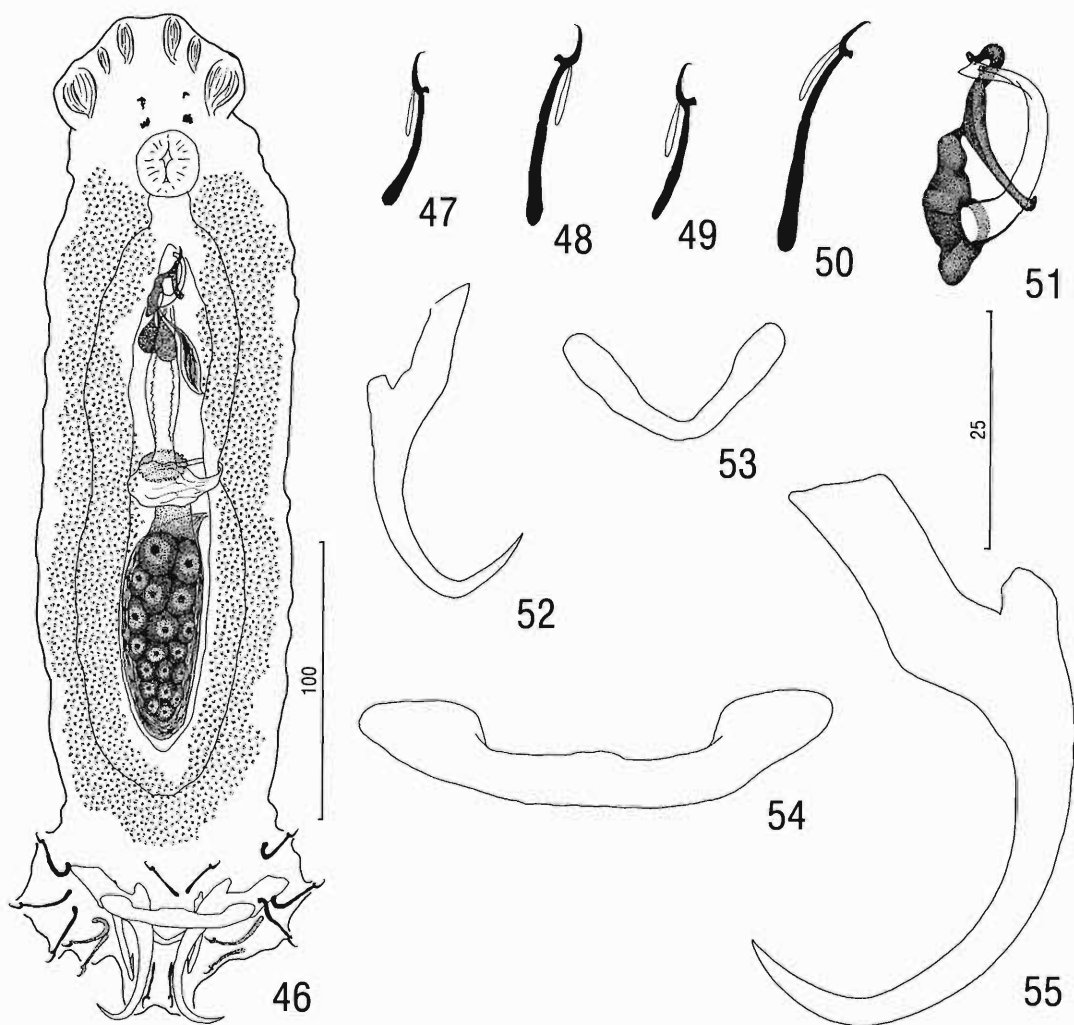
TYPE HOST AND LOCALITY: *Myleus torquatus*: Kaikuta, Rio Xingu, Pará (51°47'28"W 03°33'45"S) (12, 13 October 1992).

OTHER RECORD: *Myleus rubripinnis*: Nazaré, Rio Uatumã, Amazonas (59°57'20"W 01°30'S) (10 September 1985).

SPECIMENS STUDIED: Holotype, INPA PLH 339; 27 paratypes, INPA PLH 340, USNPC 85901, HWML 38620. 10 vouchers from *M. rubripinnis*, USNPC 85902.

COMPARATIVE MEASUREMENTS: Measurements of specimens from *M. rubripinnis* follow those of the type series in brackets.

DESCRIPTION: Body fusiform, 321 (266–371; $n = 11$) long; greatest width 96 (66–120; $n = 14$) near midlength. Cephalic lobes moderately



Figs. 46–55. *Notothecioides llewellyni* sp. n. Fig. 46. Whole mount (composite, ventral view). Fig. 47. Hook pair 1. Fig. 48. Hook pair 2. Fig. 49. Hook pair 5. Fig. 50. Hook pair 7. Fig. 51. Copulatory complex (ventral view). Fig. 52. Dorsal anchor. Fig. 53. Dorsal bar. Fig. 54. Ventral bar. Fig. 55. Ventral anchor. All figures are drawn to the 25- μ m scale, except Fig. 46 (100- μ m scale).

developed. Anterior eyes smaller than posterior eyes; accessory granules absent or present in cephalic, anterior trunk regions. Pharynx spherical, 20 (18–23; $n = 14$) in diameter. Peduncle broad to nonexistent; haptor 81 (77–86; $n = 10$) long, 95 (85–110; $n = 11$) wide. Ventral anchor 58 (55–60; $n = 12$) [50 (47–54; $n = 9$)] long, with large depressed superficial root, prominent deep root, evenly curved shaft, long point; base 26 (22–28; $n = 11$) [19 (17–21; $n = 9$)] wide. Dorsal anchor 34 (31–36; $n = 12$) [28 (27–32; $n = 8$)] long, with slender elongate superficial root, short deep root, curved shaft, long point; base

13 (12–14; $n = 9$) [9–10 ($n = 6$)] wide. Ventral bar 47 (46–49; $n = 11$) long, straight, with enlarged terminations; dorsal bar 24 (22–25; $n = 9$) long, V-shaped, with spatulate ends. Hook pair 1–18 (17–19; $n = 8$) [16–17 ($n = 4$)], pair 2–23 (22–24; $n = 6$) [18 (17–19; $n = 7$)], pair 3–24–25 ($n = 5$) [19–20 ($n = 6$)], pair 4–25–26 ($n = 5$) [21 (20–22; $n = 6$)], pair 5–17–18 ($n = 11$) [15–16 ($n = 5$)], pair 6–22 (21–23; $n = 5$) [19 (18–20; $n = 5$)], pair 7–28 (27–29; $n = 3$) [26 (23–29; $n = 3$)] long. Copulatory organ 28 (25–33; $n = 13$) [29 (25–32; $n = 8$)] long, arcuate, with flared opening; base with large

sclerotized margin. Distal rod of accessory piece 21 (18–26; $n = 12$) [25 (21–28; $n = 8$)] long, curved, variably bent distally, with indistinct thumb; proximal articulation process short. Gonads subovate; testis 56 (48–69; $n = 5$) long, 32 (25–45; $n = 5$) wide; germarium 52 (45–70; $n = 9$) long, 24 (19–32; $n = 9$) wide. Oviduct, ootype not observed; uterus with heavy wall; seminal receptacle midventral; vitellaria in trunk, except absent in regions of reproductive organs.

REMARKS: *Notothecioides llewellyni* is the type species for the genus. It is named for Dr. Jack Llewellyn, School of Biological Sciences, University of Birmingham, U.K., in recognition of his contributions to the biology and evolution of the Monogenoidea.

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